Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

MAXHB

Machines and devices of chemical and oil refining industries

Engineering calculation software

Working program of the academic discipline (Syllabus)

Details of the academic discipline

Level of higher education	***First (undergraduate)***
Branch of knowledge	*13 Mechanical engineering*
Specialty	*133 Industrial engineering*
Educational program	*Computer-integrated technologies of chemical engineering equipment design*
Discipline status	*Selective*
Form of education	*daytime*
Year of training, semester	*2nd year, autumn semester*
Scope of the discipline	*4 credits*
Semester control/ control measures	*Exam, MKR*
Lessons schedule	*http://rozklad.kpi.ua/Schedules/ScheduleGroupSelection.aspx*
Language of teaching	*Ukrainian*
Information about head of the course / teachers	*Lecturer/Practical:senior lecturer, candidate of technical sciences, R.V. Sachok net, < astet26081977@gmail.com >, art. Teacher Hryhoriy Serhiyovych Podyman*
Placement of the course	https://ci.kpi.ua/uk/syllabuses-bac-disciplines/#place

Program of educational discipline

Description of the educational discipline, its purpose, subject of study and learning outcomes

The purpose of the educational discipline.

The purpose of the educational discipline is to form students' competence:

The purpose of the educational discipline is to form students' competence:

– *the ability to apply professional knowledge to conceptualize engineering solutions;*

– *the ability to write down an algorithm or a numerical scheme, compile a program and derive and analyze its results;*

– *the ability to choose appropriate information means and communication channels depending on the situation.*

– *the ability to prepare raw data for the selection and justification of scientific, technical and organizational decisions;*

– *the ability to use knowledge to analyze engineering products, processes and methods; the ability to choose and apply appropriate analytical methods and mathematical modeling methods;*

–the ability to provide modeling of technical objects and technological processes using standard packages and means of automation of engineering calculations, to conduct experiments according to specified methods with processing and analysis of results;

1.2. The main tasks of the academic discipline.

After mastering the academic discipline, students must demonstrate the following learning outcomes:

- knowledge of system and associative methods of finding technical solutions, algorithms for solving inventive and engineering problems;

– *knowledge of basic methods of system analysis;*

– *knowledge of the basics of scientific research*

– *knowledge of modern information technologies, information databases and data banks;*

– *knowledge and understanding of general principles of operation and architecture of computer systems, mastery of system and application software.*

1. **Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)**

A list of disciplines that a student needs to master (requirements for the level of training) for successful mastery of the discipline:

- *Mathematics - 1. Analytical geometry. Differential and integral calculus.*
- *Mathematics - 2. Functions of many variables. Rows Probability theory.*
- *Engineering and computer graphics - 1. Engineering graphics.*
- *Engineering and computer graphics - 2. Computer graphics.*

2. **Content of the academic discipline**

Chapter 1. Introduction to algorithmization

Topic 1.1.*Basic concepts of computer science*

Information is given about the use of computer technology in the national economy, its role in scientific and technical progress. The structure of a personal computer and the principles of its operation are deciphered. Information about number systems, forms of representation of numbers is provided. The main stages of setting tasks on a personal computer are given. The concept of algorithm is substantiated.

Topic 1.2.*Introduction to object-oriented programming*

The main concepts and rules of object-oriented programming are considered. Examples of using object-oriented programming for solving mathematical and engineering problems.

Topic 1.3.*Basic structures of algorithms*

General information about action objects and algorithm structures is provided. Basic examples of algorithms of various types are considered. Algorithm recording types are given.

Chapter 2. Programming

Topic 2.1. Assignment operator. Input-output operators.

The syntax and principles of operation of the assignment operator are given. The syntax and principles of operation of input-output operators are given. The difference between text and numeric variables and constants is discussed.

Topic 2.2. Management operators

The syntax and principles of operation of control operators are given. The concepts of conditional and unconditional transitions are substantiated.

Topic 2.3. Conditional operators

Syntax and principles of operation of branching operators are given. The concepts of conditional and unconditional transitions are substantiated.

Topic 2.4. Loop operators

The syntax and principles of operation of loop operators are given. The syntax of a loop with a parameter, iteration loops with a precondition and a postcondition are considered.

Topic 2.5. One-dimensional arrays

Description, input, output, and basic operations with one-dimensional arrays are considered. Methods of specifying one-dimensional arrays are given.

Topic 2.6. Two-dimensional arrays

Description, input, output, and basic operations with two-dimensional arrays are considered. Methods of specifying two-dimensional arrays are given.

Topic 2.7. Combined tasks

The main approaches to solving combined problems are considered. Solving methods, algorithms and approaches to their programming.

Educational materials and resources

3.1 Basic

1. *Informatics: lecture notes [Electronic resource]: study guide for students of specialty 133 "Industrial mechanical engineering", specialization "Engineering, computer modeling and equipment design of chemical and oil refining industries" / R. V. Sachok; KPI named after Igor Sikorsky. – Electronic text data (1 file: 1.31 MB). – Kyiv: KPI named after Igor Sikorskyi, 2019. - 94 p. – Name from the screen Access:http://ela.kpi.ua/handle/123456789/27525*
2. *Bazhenov V. A. Informatics. Computer Engineering. Computer technologies: Textbook / V. A. Bazhenov, P. S. Vengerskyi, V. S. Garvona / Nauk. ed. G. A. Shinkarenko, O. V. Shishov. - K.: Karavela, 2016. - 592 p.*
3. *Berezhna O. B. Informatics and computer technology. Part 1: Education. manual / O. B. Berezhna. – Kh.: HNEU named after S. Kuznetsia, 2017. – 164 p.*
4. *I. L. Volodina Fundamentals of computer science / I. L. Volodina, V. V. Volodin. - K.: "Gymnasium" Publishing Center, 2012. - 290 p.*
5. *Glynskyi Y. M. Informatics. Workshop on information technologies: Education. manual / Ya. M. Glynskyi. – Ternopil: Textbooks and manuals, 2014. – 304 p. 5. Dybkova L. M. Informatics and computer technology: Education. manual / L. M. Dybkova. - K.: Akademvydav. - 2012. - 463 p.*

Educational content

3. Methods of mastering an educational discipline (educational component)

Lecture classes

Lectures are aimed at:

- *provision of modern, comprehensive in-depth knowledge of the discipline, the level of which is determined by the target attitude to each specific topic;*
- *provision of critical creative work together with the teacher in the process of work;*
- *education of students' professional qualities and development of their independent creative thinking;*
- *awareness of the methods of processing information resources and determining the main directions for solving specific scientific and technical problems;*
- *teaching research materials in a clear and high-quality language in compliance with structural and logical connections, clarification of all given terms and concepts available for perception by the audience.*

No s/p	The name of the topic of the lecture and a list of the main questions (a list of didactic tools, references to the literature and tasks on the SRS)	Number hours
1.	*The history of the development of computer technology. The use of computer technology in the national economy. Its role in scientific and technical progress. Computer architecture. Principle of operation. Numerical systems. Forms of representation of numbers.* *The main stages of setting problems on the computer. The concept of an algorithm.* *Literature [1–5].* *Tasks on SRS.Use of computer technology in the scientific, technical and educational process.*	*4*
2.	*Linear structure algorithms.* *Literature [1], [3], [4].* *Tasks on SRS.Algorithmic schemes.*	*4*

3.	*Selection algorithms.* *Literature [1], [3], [4].* *Tasks on SRS. Module calculation algorithm. Euclid's algorithm.*	4
4.	*Algorithms of cyclic structure.* *Literature [1], [3], [4].* *Tasks on SRS.Algorithm for calculating the product and factorial.*	4
5.	*Assignment operator.* *Literature [1], [3], [4].* *Tasks on SRS.Calculation operator*	4
6.	*Input-output operators.* *Literature [1], [3], [4].* *Tasks on SRS.Formatted output.*	4
7.	*Conditional operators. Loop operators.* *Literature [1-5].* *Tasks on SRS.Conditional blocks.*	4
8.	*One-dimensional arrays. .Two-dimensional arrays* *Literature [1-5].* *Tasks on SRS. Definition of max and min.*	4
9.	*Combined tasks* *Literature Literature [1-5].* *Tasks on SRS. Array sorting methods. Indexed sorting*	4

Laboratory work

Applicants should be helped to develop creative thinking, a creative approach to the scientific substantiation of the research direction and methodology. The main tasks of the cycle of laboratory classes:

- *prepare and evaluate given information for processing with the help of a computer;*
- *write down the corresponding algorithm in the form of an algorithmic or numerical scheme*
- *write a program that implements a complex algorithm in the high-level algorithmic language;*
- *display the result in the form of tables, graphs, documents;*
- *analyze the obtained results.*
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No s/p	***The name of the subject of the practical session and a list of the main questions (list of didactic support, references to the literature and tasks on the SRS)***	***Number Hour***
	Chapter 1. Introduction to algorithmization	
	Topic 1.1.*Basic concepts of computer science*	
1	*Introductory lesson. Familiarization with safety equipment. Initial control of incoming knowledge and skills of students. Literature [1-5]. Tasks on SRS: repeat*	*2*

	sections of higher mathematics related to informatics (series, integrals)	
2	*Working with a computer. Creating a base for future programming.Literature [1-5]. Task on SRS: to repeat the skills of working with the Windows OS.*	*2*
	Topic 1.2.*Introduction to object-oriented programming*	
4	*Getting to know the programming environment. Creating the simplest application and saving it. Environment file types.Literature [1-5]. Task on SRS: develop an application yourself.*	*2*
5	*Development of a multi-window application. Working with multiple windows. The concept of the project.Literature [1-5]. Task on SRS: to develop a project independently.*	*2*
6	*Connection of standard components. Working with the components panel.Literature [1-5]. Task on the SRS: analyze the Additional panel.*	*4*
	Topic 1.3.*Basic structures of algorithms*	
7	*Algorithms. Methods of describing algorithms.* *Literature [1-5]* *Task on SRS: To analyze the basic methods of recording algorithms from literature sources.*	*2*
8	*Algorithms. Methods of describing algorithms.* *Literature [3-5]* *Task on SRS: Analyze typical linear algorithms from literature sources.*	*2*
9	*Selection algorithms [3-5]* *Literature [3-5]* *Task on SRS: To analyze typical selection algorithms from literature sources.*	*2*
10	*Algorithms of cyclic structure.* *Literature [3-5]* *Task on SRS: To analyze typical cyclic structure algorithms from literature sources.*	*2*
11	*Iterative cycle.* *Literature [3-5].* *Task on SRS: To analyze typical algorithms of iteration cycles from literature sources.*	*2*
12	*Nested loop. Recursion. [3-5].* *Task on SRS: To analyze from literature sources typical recurrent formulas and their implementation algorithmically.*	*2*
	Chapter 2. Programming	
	Topic 2.1.*Assignment operator. Type conversion.*	
13	*Assignment operator.* *Literature [1-5]* *Task on SRS: Use the operator for changing the values of two variables, and its construction through assignment.*	*2*
	Topic 2.2.*Input-output operators*	
14	*Input-output operators.* *Literature [1-5].* *Tasks on SRS: Formatted input-output operators. Output to a file.*	*4*

	Topic 2.3.*Management operators. Conditional operators.*	
15	*Management operators* *Literature [1-5].* *Tasks on SRS: Program interruption operators.*	*2*
16	*Conditional operators* *Literature [1-5].* *Task on SRS: Using a conditional block. Examples.*	*2*
	Topic 2.4.*Loop operators*	
17	*Loop statements with a parameter* *Literature [1-5].* *Task on SRS: using nested loops with a parameter.*	*2*
18	*Loop statements with precondition and postcondition* *Literature [1-5].* *Task on SRS: use of combined nested loops.*	*2*

4. Independent work of student

Independent work makes up 50% of the study of the credit module, which includes preparation for the credit. The purpose of independent work consists in the in-depth study of methods, methods and algorithms for solving engineering, applied and scientific problems and methods of their programming.

Policy and control

5. Policy of academic discipline (educational component)

Rules of attending classes and behavior in classes

Attending classes is mandatory. Students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without valid reasons, not to interfere with the teacher conducting classes and not to be distracted by activities unrelated to the educational process.

Rules for assigning incentive and penalty points

- *incentive points can be awarded by the teacher exclusively for the performance of creative works and working hypotheses.*
  But their sum cannot exceed 25% of the rating scale.
- *Penalty points are not provided within the academic discipline.*

Policy of deadlines and rescheduling

In case of academic debts arising from the academic discipline or any force majeure circumstances, graduate students should contact the teacher to coordinate the algorithm of actions related to solving existing problems.

Policy of academic integrity

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism refers to the absence of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible tips and write-offs during writing tests, conducting classes.

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details:https://kpi.ua/code

Policy of academic behavior and ethics

Graduate students must be tolerant, respect the opinion of others, formulate objections in the correct form, adequately support feedback during classes.

Standards of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details:https://kpi.ua/code

6. Types of control and rating system for evaluating learning outcomes (RSO)

Distribution of study time by types of classes and tasks in the discipline according to the working study plan:

Semester	Training time		Distribution of study hours				Control measures		
	Credits	Acad. hours	Lectures	Practical	Lab. do	SRS	MKR	RR	Semester control
3	5.5	165	36	-	36	26	1	–	Exam

The student's rating in the discipline consists of the points he receives for:

The rating of the graduate student from the credit module consists of the points he receives for work in practical classes, lectures and MKR.

Semester control is credit.

System of rating (weighted) points and evaluation criteria

The system of rating points and evaluation criteria:

Performing tasks in practical classes.

The weighted score for laboratory classes is 4 points each;

Weighted score for MKR 18 points (2 works of 9 points each)

Weighted score for the exam is 50 points

Criteria for evaluating the performance of a practical task

Completeness and signs of task completion	***Points***
The task is fully completed	*4*
Minor defects according to point 1	*3*
Untimely completion of the task	*2.5*
Untimely completion of the task, deficiencies under clause 1	*2*
Poor performance of the task	*1*
Failure to complete the task	*0*

Thus, the rating semester scale for the credit module is:

$$R = 32 + 18 = 50 \text{ points}$$

According to the results of educational work in the first 7 weeks, the "ideal student" should score 40 points. At the first certification (8th week), the student receives "credited" if his current rating is at least 20 points.

According to the results of academic work for 13 weeks of study, the "ideal graduate student" should score 90 points. At the second certification (14th week), the graduate student receives "credited" if his current rating is at least 40 points.

The maximum number of points is 100. To receive credit from the credit module "automatically" you need to have a rating of at least 60 points.

A necessary condition for admission to credit is a rating of at least 40% of the rating scale (R), i.e. 40 points.

Postgraduate students who scored less than 0.6 R during the semester, as well as those who want to improve the overall rating, complete a credit test. At the same time, all the points they received during the semester are cancelled. Test tasks contain questions that refer to different sections of the credit module. The list of assessment questions is given in Chapter 9.

To obtain a passing grade, the sum of all rating points R received during the semester is converted according to the table:

Scores	***Rating***
95...100	*perfectly*
85...94	*very good*
75...84	*fine*
65...74	*satisfactorily*
60...64	*enough*
RD<60	*unsatisfactorily*
Admission conditions not met	*not allowed*

7. Additional information on the discipline (educational component)

An approximate list of questions submitted for semester control

The ticket consists of three questions

- *Analyze what a PC consists of. Describe the principle of PC operation.*
- *What is a number system? How are number systems classified?*
- *Give methods of conversion from decimal to binary number system.*
- *Give methods of conversion from binary to decimal number system.*
- *To reveal the main stages of setting tasks on a computer.*
- *Describe the concept of an algorithm.*
- *List and analyze the properties of the algorithm.*
- *List and analyze the properties of the objects of the algorithms.*
- *Algorithm imaging methods. Determine which are the most informative and why.*
- *Show the main blocks of the flowchart.*
- *Define a linear algorithm. Give examples.*
- *Define a branched algorithm. Give examples.*
- *Give an algorithm for finding the maximum of three given variables.*
- *Give an algorithm for finding the minimum of three given variables.*
- *Define a cyclic algorithm. Give examples.*
- *What types of cycles do you know?*
- *What is the difference between arithmetic and iteration loops?*
- *Define recursion. Give examples.*
- *Define the relationship between loop and recursion. Give examples.*
- *Give the algorithm for calculating the amount.*
- *Give the algorithm for calculating the product.*
- *Give the algorithm for calculating the factorial.*
- *What is an array? What are the types and sizes of arrays? Representation of arrays in physics and mathematics.*
- *Give an algorithm for inputting a one-dimensional array.*
- *Give an algorithm for inputting a two-dimensional array.*
- *List the alphabet of the Python language and the rules for writing identifiers.*
- *Analyze the assignment operator.*

- *List the main standard functions. List the restrictions imposed on the calculation.*
- *List input operators. To reveal the rules for issuing an "invitation".*
- *List the output operators. List the rules for deriving variables and constants.*
- *List formatted output operators. Open all formats.*
- *List the conditional operators.*
- *Analyze the operation of the conditional block operator.*
- *Give the syntax and rules of operation of arithmetic cycle operators.*
- *Give the syntax and rules of operation of arithmetic cycle operators.*
- *Explain the difference between a "with precondition" and "postcondition" cycle.*
- *Define and implement arrays.*
- *Give the syntax and rules of operation of array input operators.*
- *Show the definition of the minimum and maximum elements of a one-dimensional array.*
- *Show the definition of the minimum and maximum elements of a two-dimensional array.*
- *Show methods for sorting a one-dimensional array.*
- *Show sorting methods in a two-dimensional array. Peculiarities of sorting.*
- *Show methods of calculating a function with a given precision.*
- *To reveal the peculiarities of working with matrices in the Python environment.*

Working program of the academic discipline (syllabus):
Compiled by Roman Sachko, senior lecturer of the Department of the National Academy of Sciences of the Russian Academy of Sciences, candidate of technical sciences
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Agreed by the Methodical Commission of the faculty (protocol No. 10 dated 05/26/2023)